

Polybrominated Diphenyl Ethers (PBDEs)

Environmental Presence

Cheri Peele

June 3, 2004



Environmental Occurrence

- Function of formulation, use, degradation?
- Strongly adsorb to particles (e.g., soil, sediment, sludge)
- Decreases as bromination increases
Penta > Octa > Deca

Stability

- Reported to be extremely stable
- Now evidence that Deca-BDE debrominates in presence of UV light (Erksson et al. 2001, Olsman et al. 2002, Tylskind et al. 2001)
- Evidence that Deca-BDE metabolizes to lower brominated BDE's (Stapleton 2004, Kierkegaard 1999, Morck 2003)

Air

- Found in indoor and outdoor air
- Higher concentrations measured in indoor air than surrounding outdoors
- Concentration decreases from urban to rural areas
- Evidence of long-range transport of all PBDE's

Biosolids

Hale: Congener patterns ~ commercial mixes

- **Penta-BDE** levels 10-40X European
 - Levels consistent between sites
- **Deca-BDE** concentrations vary by site
- City of Palo Alto:
 - Deca-BDE largest concentration in biosolids (~1,183 ppb)
 - BDE-99 (part of penta-formulation) largest concentration in effluent (~0.01 ppb)

Comparison of Sludge Results (ug/kg dry weight)

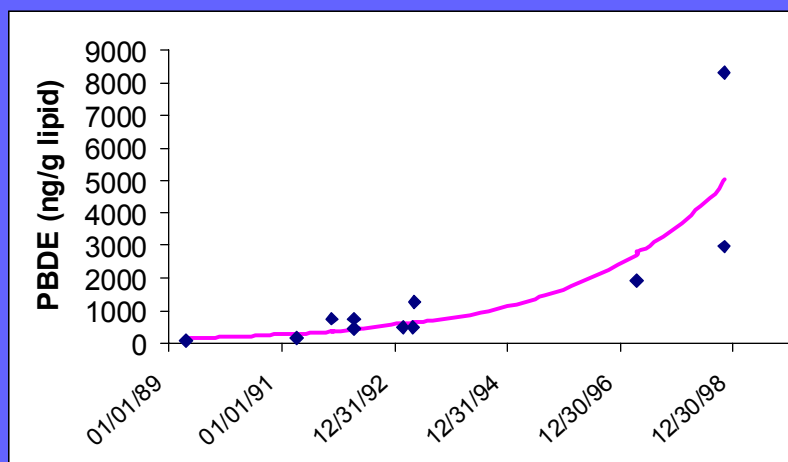
Source	Penta Formulation*	Deca- BDE
City of Palo Alto	1,918-2,086	1,010-1,440
Hale's study (Throughout U.S.)	1,100-2,290	85-4,890
European Studies	0.4-239	140-350

*sum of “penta-like” congeners

Biota

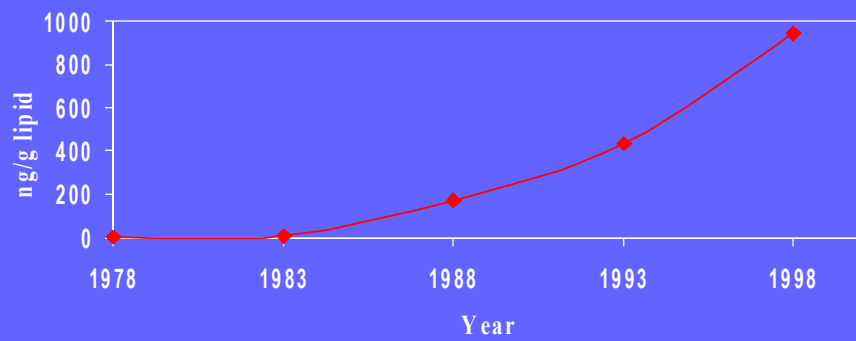
- Found over wide geographical range in wide range of species
- Increasing rapidly over time
- Congener composition varies in different specimens

Time-trend: PBDEs in Blubber of California Seals (She et al., 2002)



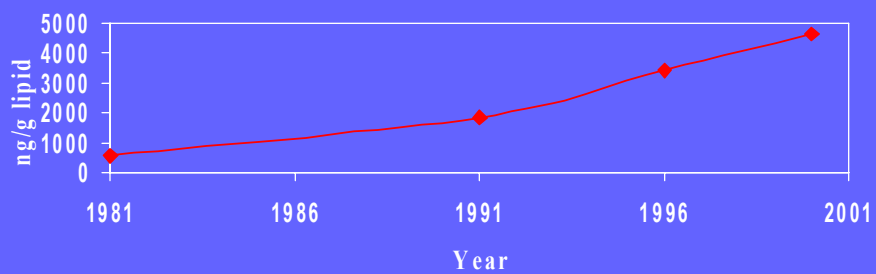
N=11

PBDEs in Lake Ontario Trout (1978 - 1998)



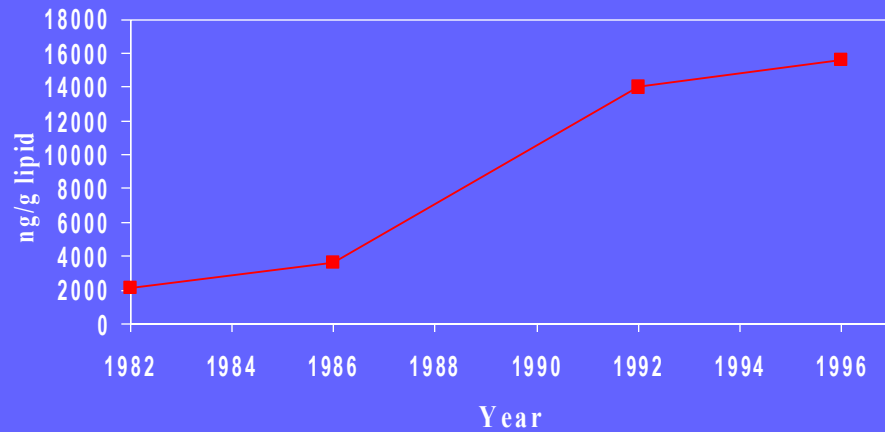
Luross et al. (2000)

PBDEs in Canadian Ringed Seals (1981 - 2000)



Ikonomou et al. (2002)

PBDEs in Canadian Beluga Whales (1982 – 1997)



Stern and Ikononou (2000)

Fish

- Fish from different sites have distinct congener patterns
- Study by Rayne, et al (2003) documented increasing PBDE concentrations in Columbia River fish monitored from 1992 – 2000.
- Study by Johnson and Olson (2001) documenting occurrence of PBDEs in Washington State freshwater fish.

Birds

- High concentrations (some exceeding 1 ppm) of PBDEs found, have been in eggs from eagles and cormorants from nests along the Columbia River and the Hood Canal area (Peterman - 2001).
- Deca-BDE detected in barn owls, herons, sparrowhawks, kestrels, Ospreys, White tailed eagles, Glaucous gulls, peregrine falcons, red kites and great crested grebes

Data Gaps

- Fate and transport processes involved in environmental movement
- Commercial products breaking down in environment or biota?
- If so, what are resultant products?
- What exposure levels should be of concern?